PB-241 164

ROCHDALE POND, WORCESTER COUNTY, MASSACHUSETTS

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Environmental Research Center
Massachusetts National Guard
Massachusetts Water Resources Commission

March 1975

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TECHNICAL REPORT DATA
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1. REPORT NO.	2.	3. PB 241 164
4. TITLE AND SUBTITLE: Report on Rochdale Pond, Worcester County, Massachusetts		5. REPORT DATE: Prepared March 1975 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S): Anonymous (National Eutrophication Survey Staff)		8. PERFORMING ORGANIZATION REPORT NO.: Working Paper # 222
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Pacific Northwest Environmental Research Laboratory U.S.Environmental Protection Agency 200 S. W. 35th St. Corvallis, Oregon 97330		10. PROGRAM ELEMENT NO.: 1BA029 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS: Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED: Final - 1972 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

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INFORMATION SERVICE
US Department of Commerce
Springfield, VA. 22151

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18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release unlimited		36
	20. SECURITY CLASS (This page)	22. PRICE $3.15/2.25

EPA Form 2220-1 (9-73)

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Massachusetts Division of Water Pollution Control for professional involvement and to the Massachusetts National Guard for conducting the tributary sampling phase of the Survey.

Thomas C. McMahon, Director, John R. Elwood, Supervisory Sanitary Engineer, Eben Chesebrough, Senior Chemist, and Peter A. Tennant, Senior Sanitary Engineer of the Massachusetts Division of Water Pollution Control provided invaluable lake documentation and counsel during the course of the Survey.

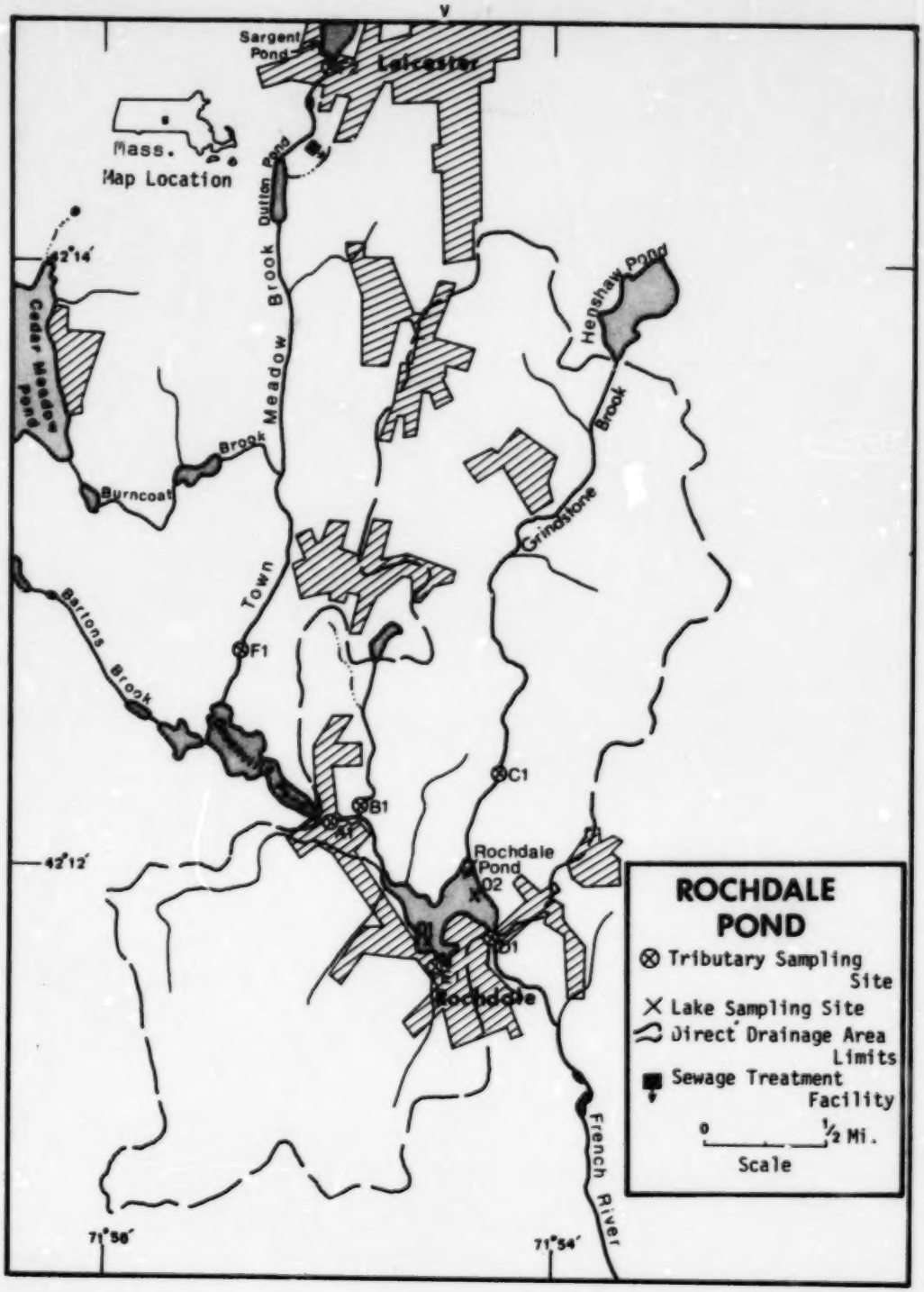
Major General Vahan Vartanian, the Adjutant General of Massachusetts, and Project Officer Major William Flaherty, who directed the volunteer efforts of the Massachusetts National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MASSACHUSETTS

LAKE NAME	COUNTY
Assabet-Concord River Impoundments	
Northboro	Worcester
Hudson	Middlesex
Maynard	Middlesex
Billerica	Middlesex
Hager Pond	Middlesex
Matfield Impoundment	Plymouth
Rochdale Pond	Worcester
Woods Pond	Berkshire


Sargent Pond
Leicester
Mass.
Map Location
Dutton Pond
Meadow Brook
Cedar Meadow Pond
Burncoat Brook
Henshaw Pond
Brook
Grindstone
Town
Bartons Brook
F1
C1
B1
A1
Rochdale Pond
02
01
Rochdale
French River
42°14'
42°12'
71°56'
71°54'
ROCHDALE POND
Tributary Sampling Site
Lake Sampling Site
Direct Drainage Area Limits
Sewage Treatment Facility
0
½ Mi.
Scale

ROCHDALE POND

STORET NO. 2509

I. CONCLUSIONS

A. Trophic Condition:

Rochdale Pond, one of several small impoundments in the headwaters of the French River system, is characterized by slightly acid, brownish colored waters with low transparency and low to moderate productivity. Rooted aquatic plants are scarce, and the relatively low phytoplankton crops are represented primarily by diatoms and Chlorococcales of the types commonly associated with eutrophic water bodies. The high humic content and acid nature of the water are suggestive of dystrophic conditions.

B. Rate-Limiting Nutrient:

From a nutrient standpoint, the results of the algal assay indicate that Rochdale Pond was nitrogen limited at the time the sample was collected (10/06/72). The pond data also indicate nitrogen limitation; i.e., the inorganic nitrogen/dissolved phosphorus ratios ranged from 4/1 to 8/1, and nitrogen limitation would be expected.

However, the humic colored water, the composition and quantity of phytoplankton associated with relatively high nutrient levels, and the Secchi disc transparency, indicate that the primary productivity of the pond more likely was light-limited.

C. Nutrient Controllability:

1. Point sources--During the sampling year, Rochdale Pond received a total phosphorus load at a rate over three times that proposed by Vollenweider (in press) as "dangerous"; i.e., a eutrophic rate (see page 14). Now, Vollenweider's model probably does not apply to water bodies with short hydraulic retention times, and the mean hydraulic retention time of Rochdale Pond is a short 4½ days. Nonetheless, the existing trophic condition of the pond is evidence of excessive nutrient loads.

It is calculated that the Village of Leicester contributed 9% of the total phosphorus load to the pond during the sampling year. Even complete removal of phosphorus at this source would only reduce the total phosphorus load to the pond to 61.5 lbs/acre/yr (6.9 $g/m^2/yr$); and it does not appear likely that phosphorus control at the Leicester wastewater treatment plant at this time would result in a significant improvement in the trophic condition of Rochdale Pond. However, if the phosphorus contribution of the plant is increased in the future, the need for phosphorus removal should be re-evaluated.

It is noted that there was an apparent loss of phosphorus from the pond during the sampling year. It is believed that the "loss" is the result of underestimation of phosphorus loads in the process wastewater of the Carleton Woolen Company which

is discharged to the French River below the outlet of Rochdale Pond but upstream from the Survey outlet sampling station. The loads from this source (subtracted from Survey outlet loads) were calculated on the basis of a 12-hour-day operation (Anonymous, 1973); however, the mill more commonly operates 24 hours a day (Chesebrough, 1975).

2. Non-point sources--During the sampling year, the phosphorus export rates of the French River and the unnamed tributary (E-1) were appreciably greater than the export rate of Grindstone Brook (see page 14). The higher export rate of the French River may be due to underestimation of the Leicester load, but the much higher export rate of the unnamed stream may be due to urban drainage in the community of Rochdale.

It is calculated that the non-point phosphorus exports of the measured tributaries total about 86% of the total phosphorus load to the pond during the sampling year.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 41 acres.
2. Mean depth: 5.9 feet.
3. Maximum depth: 16 feet.
4. Volume: 242 acre-feet.
5. Mean hydraulic retention time: 4½ days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
French River	14.0 mi^2	19.7 cfs
Grindstone Brook	2.5 mi^2	3.5 cfs
Unnamed tributary (E-1)	0.7 mi^2	1.0 cfs
Minor tributaries & immediate drainage -	1.6 mi^2	2.4 cfs
Totals	18.8 mi^2	26.6 cfs

2. Outlet -

French River	18.9 mi^2**	26.6 cfs

C. Precipitation***:

1. Year of sampling: 71.7 inches.
2. Mean annual: 45.2 inches.

† Chesebrough, 1975; mean depth by random-dot method.
* Drainage areas are accurate within ±1%; gaged mean daily, monthly, and normalized monthly flows are accurate within ±15%; and ungaged mean daily, monthly, and normalized flows are accurate within ±20%.
** Includes area of lake.
*** See Working Paper No. 1, "Survey Methods, 1972".

III. LAKE WATER QUALITY SUMMARY

Rochdale Pond was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the pond and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the two stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 10 feet at station 1 and 8 feet at station 2.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the pond essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (10/06/72)		
Temperature (Cent.)	14.2	14.7	14.8	15.0
Dissolved oxygen (mg/l)	6.0	7.4	7.4	8.6
Conductivity (μmhos)	80	124	135	155
pH (units)	6.6	6.7	6.7	6.9
Alkalinity (mg/l)	10	12	10	16
Total P (mg/l)	0.045	0.059	0.063	0.072
Dissolved P (mg/l)	0.021	0.027	0.026	0.033
NO_2 + NO_3 (mg/l)	0.030	0.040	0.040	0.050
Ammonia (mg/l)	0.070	0.075	0.070	0.090
		ALL VALUES		
Secchi disc (inches)	36	43	38	57

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/04/72	1. Scenedesmus	226
	2. Asterionella	226
	3. Synedra	93
	4. Fragilaria	75
	5. Nitzschia	69
	Other genera	218
	Total	907
08/04/72	1. Dictyosphaerium	831
	2. Dinobryon	470
	3. Gloeocapsa	145
	4. Scenedesmus	136
	5. Cyclotella	118
	Other genera	316
	Total	2,016
10/06/72	1. Scenedesmus	1,175
	2. Flagellates	331
	3. Dinobryon	316
	4. Fragilaria	271
	5. Asterionella	151
	Other genera	1,084
	Total	3,328

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/04/72	01	(not done)
	02	5.0
08/04/72	01	19.8
	02	23.7
10/06/72	01	12.1
	02	11.3

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.033	0.248	5.5
0.010 P	0.043	0.248	5.3
0.020 P	0.053	0.248	5.2
0.050 P	0.083	0.248	5.3
0.050 P + 5.0 N	0.083	5.248	27.2
0.050 P + 10.0 N	0.083	10.248	27.4
10.0 N	0.033	10.248	11.1

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Rochdale Pond was moderately high at the time the assay sample was collected (10/06/72).

Also, the results indicate the pond was nitrogen limited. Note that spikes of phosphorus alone did not stimulate a

growth response, but the addition of nitrogen alone resulted in a yield significantly greater than the control yield.

The pond data indicate nitrogen limitation in August as well (the N/P ratio was 6/1) but phosphorus limitation in June (the N/P ratio was 30/1).

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Massachusetts National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of March and April when two samples were collected at most stations. Sampling was begun in September, 1972, and was completed in September, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the New England District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the nutrient loads, in $lbs/mi^2/yr$, in Grindstone Brook at station C-1 and multiplying by the ZZ area in mi^2.

The community of Leicester did not participate in the Survey, and nutrient loads were determined using nutrient and flow data obtained by the Massachusetts Division of Water Pollution Control**.

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* See Working Paper No. 1.
** Anonymous, 1973.

Also, Carleton Woolen Company discharges untreated process wastewater to the French River below the outlet of Rochdale Pond but upstream from the Survey pond outlet sampling station (D-1). Nutrient loads from this source also were calculated using nutrient and flow data obtained by the Massachusetts Division of Water Pollution Control*, and these loads (1,760 lbs P and 54,950 lbs N) were subtracted from the Survey outlet nutrient loads measured at station D-1.

A. Waste Sources*:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Leicester	100**	sand filter	0.025	Trib. to Town Meadow Brook

2. Known industrial -

Name	Product	Treatment	Mean Flow (mgd)	Receiving Water
Carleton Woolen Mills	woolens	none	0.743 (12-hour day)	French River (upstream from Survey site D-1)

* Anonymous, 1973.
** Estimated from measured total phosphorus load (2.5 lbs/capita/year).

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
French River	1,980	71.5
Grindstone Brook	200	7.2
Unnamed tributary (E-1)	200	7.2
b. Minor tributaries & immediate drainage (non-point load) -	130	4.7
c. Known municipal STP's -		
Leicester	250	9.0
d. Septic tanks - Unknown	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	10	0.4
Total	2,770	100.0

2. Outputs -

Pond outlet - French River 3,460

3. Net annual P loss - 690 pounds

* See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/yr	% of total
a. Tributaries (non-point load) -		
French River	41,160	60.4
Grindstone Brook	13,370	19.6
Unnamed tributary (E-1)	3,290	4.8
b. Minor tributaries & immediate drainage (non-point load) -	8,560	12.6
c. Known municipal STP's -		
Leicester	1,400	2.0
d. Septic tanks - Unknown	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	390	0.6
Total	68,170	100.0

2. Outputs -

Pond outlet - French River 55,950

3. Net annual N accumulation - 12,220 pounds

* See Working Paper No. 175.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr
French River	141	2,940
Grindstone Brook	80	5,348
Unnamed tributary (E-1)	286	4,700

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with very short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	67.7	loss*	1,662.7	298.0
grams/m^2/yr	7.57	-	186.4	33.4

Vollenweider loading rates for phosphorus (g/m^2/yr) based on mean depth and mean hydraulic retention time of Rochdale Pond:

"Dangerous" (eutrophic rate)	2.26
"Permissible" (oligotrophic rate)	1.13

* See discussion, page 2.

V. LITERATURE REVIEWED

Anonymous, 1973. French and Quinebaug rivers, 1972: Part B. List of wastewater discharges. MA Div. of Water Poll. Contr., Boston.

Chesebrough, Eben W., 1975. Personal communication (review of preliminary report; pond morphometry; Carleton Woolen Company discharge). MA Div. of Water Poll. Contr., Westboro.

Vollenweider, Richard A. (in press). Input-output models. Scheiwz. Z. Hydrol.

VI. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MASSACHUSETTS 11/26/74

LAKE CODE 2509 ROCHDALE POND

TOTAL DRAINAGE AREA OF LAKE 18.90

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2509A1	14.00	21.40	21.60	40.70	41.20	22.50	14.10	9.14	9.88	11.20	10.70	16.40	18.20	19.73
2509C1	2.47	3.79	3.80	7.18	7.24	3.98	2.49	1.62	1.74	1.98	1.89	2.89	3.21	3.48
2509D1	18.90	28.90	29.10	55.00	55.60	30.40	19.10	12.40	13.30	15.10	14.50	22.10	24.60	26.64
2509E1	0.72	1.10	1.11	2.10	2.12	1.16	0.73	0.47	0.51	0.58	0.55	0.84	0.94	1.02
2509Z2	1.71	2.62	2.63	4.98	5.03	2.75	1.73	1.12	1.21	1.37	1.31	2.00	2.22	2.41

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 18.90
SUM OF SUB-DRAINAGE AREAS = 18.90

TOTAL FLOW IN = 320.01
TOTAL FLOW OUT = 320.10

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2509A1	9	72	10.10	9	9.48				
	10	72	12.50	14	15.30				
	11	72	40.50	11	46.10				
	12	72	54.10	9	80.90				
	1	73	31.50	13	22.80				
	2	73	11.00	10	10.30				
	3	73	31.80	10	60.30	24	24.10		
	4	73	44.50	14	40.70	28	70.70		
	5	73	31.70	12	43.80				
	6	73	21.30	9	10.70				
	7	73	25.20	14	16.50				
	8	73	14.10						
	9	73	12.50	8	9.48				
2509C1	9	72	1.80	9	1.70				
	10	72	2.20	14	2.70				
	11	72	7.10	11	8.10				
	12	72	9.50	9	14.30				
	1	73	5.60	13	4.88				
	2	73	1.90	10	1.80				
	3	73	5.40	10	10.60	24	4.20		
	4	73	7.80	14	7.20	28	12.50		
	5	73	5.60	12	7.70				
	6	73	3.80	9	1.90				
	7	73	4.50	14	2.90				
	8	73	2.50	11	2.40				
	9	73	2.20	8	1.70				

TRIBUTARY FLOW INFORMATION FOR MASSACHUSETTS 11/26/74

LAKE CODE 2509 ROCHDALE POND

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
250901	9	72	13.40	9	12.70				
	10	72	17.00	14	20.60				
	11	72	54.60	11	62.20				
	12	72	73.10	9	109.00				
	1	73	42.50	13	30.80				
	2	73	14.90	10	13.90				
	3	73	43.00	10	81.50	24	32.50		
	4	73	60.00	14	55.00	28	95.40		
	5	73	42.90	12	59.20				
	6	73	28.80	9	14.50				
	7	73	34.20	14	22.30				
	8	73	19.00	26	12.70				
	9	73	16.90	8	12.70				
2509E1	9	72	0.50	9	0.50				
	10	72	0.60	14	0.80				
	11	72	2.10	11	2.40				
	12	72	2.80	9	4.20				
	1	73	1.60	13	1.20				
	2	73	0.60	10	0.50				
	3	73	1.40	10	3.10	24	1.20		
	4	73	2.30	14	2.10	28	3.60		
	5	73	1.60	12	2.30				
	6	73	1.10	9	0.55				
	7	73	1.30	14	0.85				
	8	73	0.70	26	0.48				
	9	73	0.60	8	0.48				
2509Z7	9	72	1.20						
	10	72	1.50						
	11	72	4.90						
	12	72	6.60						
	1	73	3.90						
	2	73	1.30						
	3	73	3.90						
	4	73	5.40						
	5	73	3.90						
	6	73	2.40						
	7	73	3.10						
	8	73	1.70						
	9	73	1.50						

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/11/26

250901
42 11 45.0 071 54 17.0
ROCHDALE POND
25 MASSACHUSETTS

11EPALES
3

2111202
0008 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/04	12 30	0000	20.5	8.8	38	70	6.60	10K	0.090	0.040	0.063	0.027
	12 30	0010	14.6	6.0		950	6.20	10K	0.730	0.960	0.062	0.028
72/08/04	13 05	0000			36	199	6.55	12	0.100	0.240	0.109	0.071
	13 05	0004	23.8	6.0		248	6.55	12	0.240	0.450	0.094	0.064
72/10/06	12 45	0000			57	80	6.80	10K	0.040	0.070	0.072	0.033
	12 45	0004	15.0	8.6		90	6.90	16	0.040	0.070	0.065	0.027
	12 45	0007	14.7	8.2		120	6.75	14	0.050	0.090	0.064	0.030

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/08/04	13 05	0000	19.8J
72/10/06	12 45	0000	12.1J

K VALUE KNOWN TO BE LESS THAN INDICATED

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/11/26

250902
42 11 51.0 071 54 33.0
ROCHDALE POND
25 MASSACHUSETTS

11EPALES
3

2111202
0008 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/04	12 50	0000	20.5	9.0	37	90	6.90	10K	0.060	0.060	0.039	0.009
	12 50	0008	12.3	6.2		460	6.50	10K	0.360	0.380	0.042	0.025
72/08/04	13 15	0000			36	190	6.70	10	0.070	0.140	0.079	0.053
	13 15	0004	24.3	7.6		185	6.80	11	0.080	0.130	0.082	0.055
72/10/06	13 00	0000			55	150	6.70	10K	0.030	0.080	0.062	0.021
	13 00	0004	14.9	6.7		150	6.65	10K	0.040	0.070	0.048	0.023
	13 00	0006	14.2	6.0		155	6.65	10K	0.040	0.070	0.045	0.026

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/04	12 50	0000	5.0J
72/08/04	13 15	0000	23.7J
72/10/06	13 00	0000	11.3J

K VALUE KNOWN TO BE LESS THAN INDICATED

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY DATA

STORET RETRIEVAL DATE 74/11/26

2509A1 LS2509A1
42 12 00.0 071 55 00.0
OUTLET OF GREENVILLE POND
25 7.5 LEICESTER
I/ROCHDALE POND
PLEASANT ST BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/09	11 30		0.046	0.500	0.076	0.018	0.068
72/10/14	17 40		0.100	0.850	0.085	0.024	0.071
72/11/11	08 00		0.195	1.200	0.005K	0.029	0.065
72/12/09	09 00		0.189	0.400	0.046	0.017	0.037
73/01/13	08 15		0.168	0.400	0.048	0.012	0.025
73/02/10	09 00		0.176	0.420	0.110	0.025	0.035
73/03/10	09 00		0.198	1.200	0.357	0.040	0.065
73/03/24			0.170	3.300	0.088	0.013	0.045
73/04/28			0.120	0.520	0.035	0.038	0.075
73/05/12	09 00		0.110	0.560	0.020	0.027	0.065
73/06/09	13 30		0.022	1.200	0.066	0.029	0.065
73/07/14	12 00		0.240	0.840	0.120	0.032	0.060
73/09/08			0.034	0.960	0.063	0.008	0.060

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

250981 LS250981
42 12 00.0 071 55 00.0
NO NAME
25 7.5 LEICESTER
T/ROCHDALE POND
UNIMPROVED RD BRDG S EDGE OF GREENVILLE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/09	11 40		0.350	1.000	0.100	0.015	0.189
72/10/14	07 45		0.180	0.350	0.132	0.005K	0.010
72/11/11	08 15		0.221	0.420	0.005K	0.005K	0.022
73/02/10	09 15		0.600	0.660	0.090	0.007	0.010
73/03/10	09 15		0.510	1.150	0.460	0.010	0.020
73/03/24			0.450	1.680	0.037	0.005K	0.010
73/04/14	11 40		0.350	0.540	0.031	0.009	0.015
73/04/28			0.147	0.880	0.058	0.006	0.010
73/05/12	08 30		0.072	0.650	0.025	0.007	0.015
73/06/09	12 05		0.380	0.420	0.006	0.006	0.020
73/07/14	11 50		0.210	1.760	0.170	0.012	0.020
73/08/11	12 15		0.210	0.690	0.079	0.009	0.020
73/09/08			0.160	2.600	0.147	0.005K	0.040

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

2509C1 LS2509C1
42 12 30.0 071 55 00.0
GRINDSTONE BROOK
25 7.5 LEICESTER
T/ROCHDALE POND
ST HWY 56 BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/09	12 00		0.400	1.200	0.189	0.022	0.073
72/10/14	08 15		0.062	1.300	0.115	0.012	0.012
72/11/11	08 20		0.044	0.630	0.005K	0.005K	0.017
72/12/09	10 00		0.160	1.470	0.031	0.006	0.013
73/01/13	07 35		0.154	0.710	0.075	0.005K	0.015
73/02/10	10 00		0.151	0.880	0.144	0.010	0.010
73/03/10	08 00		0.138	5.800	0.200	0.007	0.015
73/03/24			0.115	0.895	0.037	0.005K	0.010
73/04/14	11 52		0.050	0.690	0.052	0.005K	0.005K
73/04/28			0.052	0.860	0.039	0.008	0.012
73/05/12	08 15		0.062	1.000	0.044	0.009	0.025
73/06/09	11 00		0.130	2.300	0.120	0.025	0.050
73/07/14	12 05		0.175	2.900	0.200	0.028	0.065
73/08/11	10 30		0.154	2.400	0.105	0.036	0.070
73/09/08			0.410	3.700	0.176	0.010	0.045

K VALUE [illegible]
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

2509D1 LS2509D1
42 12 00.0 071 54 30.0
FRENCH RIVER
25 7.5 LEICESTER
O/ROCHDALE POND
BELO MILL DAM AT ROCHDALE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/09	11 45		0.042	1.150	0.120	0.017	0.077
72/10/14	08 05		0.150	0.900	0.180	0.036	0.095
72/11/11	07 30						0.058
72/12/09	10 15		0.230	0.840	0.087	0.017	0.046
73/01/13	07 30		0.168	0.560	0.052	0.013	0.035
73/02/10	10 30		0.189		0.940	0.011	0.063
73/03/10	08 45		0.260	1.260	0.190	0.032	0.055
73/03/24	08 00		0.210	1.100	0.090	0.013	0.030
73/04/14	11 50		0.160	3.900	0.510	0.088	0.125
73/04/29			0.132	0.930	0.051		0.073
73/05/12	09 15		0.079	0.660	0.017	0.018	0.055
73/06/09	13 10		0.060	3.200	0.290	0.068	0.220
73/07/14	13 45		0.330	2.800	0.140	0.048	0.230
73/08/26	11 45		0.046	5.400	1.800	0.132	0.230
73/09/08			0.028	2.600	0.260	0.021	0.090

STORET RETRIEVAL DATE 74/11/26

2509E1 LS2509E1
42 12 00.0 071 54 30.0
NO NAME
25 7.5 LEICESTER
T/ROCHDALE POND
RIVER ST BRDG NW EDGE OF ROCHDALE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/09			0.390	1.050	0.470	0.044	0.300
72/10/14	07 50		0.170	0.750	0.140	0.022	0.036
72/11/11	07 00		0.120	1.700	0.005K	0.015	0.190
72/12/09	12 00		0.210	1.600	0.099	0.021	0.044
73/01/13	08 30		1.060	0.630	0.135	0.007	0.025
73/02/10	10 30		0.890	0.170	0.072	0.005K	0.015
73/03/10	08 35		0.600	2.400	0.140	0.006	0.025
73/03/24			0.600	0.690	0.048	0.009	0.020
73/04/14	11 47		0.620	0.820	0.042	0.011	0.015
73/04/28			0.360	0.400	0.027	0.012	0.020
73/05/12	09 30		0.210	0.410	0.025	0.012	0.025
73/06/09	12 30		0.200	2.100	0.250	0.026	0.070
73/07/14	12 00		0.300	1.470	0.060	0.019	0.060
73/08/26	11 20		0.252	1.800	0.240	0.054	0.250
73/09/08			0.014	2.500	0.980	0.076	0.370

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

2509F1 LS2509F1
42 12 30.0 071 55 30.0
TOWN MEADOW BROOK
25 7.5 LEICESTER T
/ROCHDALE POND
GREEN ST BRDG BELO LEICESTER STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/09	11	15	0.470	0.450	0.092	0.210	0.292
72/10/14	07	35	0.140	0.500	0.085	0.054	0.079
72/11/11	07	15	0.195	0.790	0.005K	0.040	0.068
73/01/13	08	00	0.390	0.560	0.16A	0.084	0.140
73/03/10	08	20	0.168	1.680	0.120	0.028	0.050
73/03/29			0.220	0.780	0.105	0.038	0.050
73/04/28			0.126	0.480	0.056	0.060	0.085
73/05/17	08	15	0.160	0.630	0.046	0.061	0.100
73/06/09	11	30	0.280	1.600	0.050	0.10A	0.155
73/07/14	11	30	0.016	0.925	0.100	0.023	0.185
73/08/24	12	15	0.189	0.270	0.054	0.154	0.210
73/09/08			0.210	1.570	0.06A	0.189	0.260

< VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

2509F2 LS2509F2
42 14 30.0 071 55 00.0
TOWN MEADOW BROOK
25 705 LEICESTER
T/ROCHDALE POND
RT 9 BRDG ABOV LEICESTER STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/09	11 55		0.530	0.950	0.152	0.160	0.250
72/10/14	07 30		0.082	0.550	0.115	0.005K	0.018
72/11/11	09 00		0.100	2.940	0.005K	0.006	0.019
72/12/09	12 35		0.115	0.290	0.027	0.005K	0.014
73/02/10	12 00		0.090		0.033	0.005K	0.020
73/03/10	08 15		0.110	1.540	0.530	0.011	0.020
73/04/28			0.026	0.280	0.010	0.006	0.010
73/05/12	08 00		0.023	0.440	0.019	0.006	0.015
73/06/09	14 05		0.010K	0.630	0.065	0.007	0.012
73/07/14	11 00		0.240	2.200	0.176	0.005K	0.020
73/08/26	13 30		0.014	0.935	0.072	0.005K	0.015
73/09/04			0.016	1.540	0.060	0.007	0.025

K VALUE KNOWN TO BE
LESS THAN GIVEN VALUE